

Tracheotomy in Children

A Controlled, Planned Emergency Procedure

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WHEN TO PERFORM TRACHEOTOMY and how to perform it are questions of primary importance in the management of respiratory obstruction in children. Treatment of the various problems which may require tracheotomy will not be discussed in this paper. It is assumed that every reasonable therapeutic means is always used to avoid surgical intervention in a critically sick child. However, it is the danger of the unreasonable efforts to avoid operation, and the methods of performing the delayed operation, with which this paper is most concerned. The ideas presented are certainly not original, but as a method of procedure they have been found useful in the management of cases of respiratory obstruction at Children's Hospital of the East Bay.

Until fairly recently, tracheotomy was used only as a last resort when death was virtually certain without it. Experience gained in the management of bulbar poliomyelitis⁵ in the early 1940's has resulted in a gradual broadening of the indications for performing tracheotomy.

The indications, generally accepted today, are well stated by a number of authors.^{1,2,6,7,10} In addition to the circumvention of a fixed upper respiratory tract obstruction, tracheotomy may be utilized to by-pass pooled secretions, to reduce the anatomical dead space (which it does by half), to reduce respiratory resistance by eliminating friction at the normal laryngeal valve and to give direct access to the tracheobronchial tree for the management of fluid obstructions of the lower respiratory tract and the maintenance of tracheal toilet.

These factors may at times be useful in managing a variety of conditions including acute injuries⁸ (head injuries, jaw fractures, severe burns), acute infections (tetanus, encephalitis, poliomyelitis), cerebrovascular accidents, various causes of pulmonary failure¹ and the administration of anesthesia in certain injuries or cases of arthritic or cicatricial fixation of the neck and jaws.

The determination of the time to intervene surgically in the relief of respiratory obstruction is a matter of considerable judgment, and may in some

• The value of tracheotomy as a life-saving operation has been increased greatly in recent years by a broadening of the indications for its use. It is made safer for the patient by performing it reasonably early, and, in any event, under planned emergency conditions. The first is made possible by experience and judgment in choosing the time, mainly from close observation of the patient; the second by preceding the operation with tracheal intubation. Meticulous post-operative care is of great importance.

cases represent the combined opinions of several physicians of different special skills. The broadened concept of the indications for and the value of tracheotomy has brought the realization that it need not be a last-resort emergency operation. It is this point that should be stressed in the management of the more common condition of transitory fixed upper respiratory tract obstruction such as is seen in cases of acute inflammation of the glottic area in children.

The decision regarding whether to operate or give the patient a further test of time can only be made after careful observation. The child should be watched, if possible, through a period of agitation (which usually accompanies the performance of certain nursing duties) and a period of rest. It is important to plan all the necessary, uncomfortable manipulations such as the taking of temperature, drawing blood, getting material from the throat for culture and the giving of injections, and do them at one time rather than disturb the child repeatedly. This will permit earlier and easier evaluation of the patient's respiratory status.

If, after a period of observation, the child is noticeably tiring, and there is no reasonable expectation that the obstruction will spontaneously reverse within a few hours, it is wise to perform a tracheotomy at that time rather than to risk having to do an emergency last-resort operation. In this regard, the facial expression and emotional state (presence of agitation) are more reliable signs of anoxia and fatigue than is the patient's color. If one waits for the occurrence of cyanosis before relieving obstruction, the prolonged anoxia may disturb respiratory physiologic processes to such an extent¹⁰ that the pa-

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tient's recovery is greatly jeopardized. In severe respiratory acidosis the patient may arrive at a point at which the only remaining stimulus to respiration is the effect of the anoxemia on the carotid and aortic chemoreceptors, which have become the peripheral respiratory centers. In this event, attempts to correct anoxemia without removing the obstruction would be expected to cause apnea and death.

If one feels that a test of time is justified, there are certain details that must be considered. The patient should be clearly visible and audible to a trained attendant at all times. Some, otherwise very satisfactory, individual humidification units become so foggy inside and the nebulizer makes so much noise that the patient cannot be seen or heard by the nursing staff, unless the unit is placed very close to the nursing station or personnel is assigned to work in the room or ward continuously.

If the child is excessively upset, particularly on being confined in a tent, the best solution may be to insist that one of the parents stay at the bedside and attempt to soothe him with appropriate caresses. Rarely the parent may be inadequate to the occasion, in which case a frank discussion followed by trial of the other parent if available; or elimination of this feature entirely may be necessary. There is frequently a temptation to use sedation in an effort to prevent the child's increasing his problem by general physical exertion and local traumatic impact on the glottis. If one can be sure that the agitation is owing to temper or unhappiness or fear, and not to anoxia, a modest dose of sedative can be very helpful. The exceptional child who reacts with more excitement, or conversely, who quickly becomes stuporous, may create an additional problem for the physician; and certainly the knowledge that this can occur should make one quite cautious in the use of sedatives.

Finally, it is essential to have a feasible plan in the event the patient becomes suddenly worse, contrary to expectations. The classical order to cover this contingency has always been "tracheotomy tray at bedside." Even with the tray at hand, the prospect of carrying out tracheotomy at the bedside is not pleasant. From the procedure of doing tracheotomy over a bronchoscope, the author, having the assistance of excellent anesthesiologists, became accustomed to do it over a flexible endotracheal tube. From this a logical step was to substitute intubation equipment, first bronchoscopes and later endotracheal tubes, for the bedside tracheotomy tray. The intubation sets that are used contain appropriate sized battery-powered laryngoscopes, an assortment of endotracheal tubes, soft rubber aspiration catheters and a bite block. It is generally accepted that it is easier and safer to perform in-

tubation than tracheotomy, under conditions existing at the patient's bedside.

Thus, with the aid of tracheal intubation instruments, tracheotomy is converted to a planned emergency whether it be in the ward, in the emergency room or in surgery. If done in surgery, the anesthesiologist proceeds as he would for endotracheal anesthesia in any other kind of case. It is advisable to have a rigid bronchoscope ready in the event of unforeseen difficulty. The anesthetic is induced with nitrous oxide-oxygen mixture, the larynx exposed and inspected and the endotracheal tube inserted. From then on the procedure is carried out in an unhurried, orderly manner.

A short transverse incision is used in the skin at a level midway between the cricoid cartilage and the superior border of the sternum. In selecting this level, the patient's head should be moderately extended by placing a towel roll or a sandbag under the shoulders. The deep fascia is exposed and incised in a vertical plane. The dissection is mainly blunt and is carried down to the trachea without skeletonizing it. A vertical incision is made through two exposed rings; the isthmus of the thyroid gland, if exposed, is usually displaced upward. It has been found that with the foregoing procedure, the tracheostomy will usually be made through the third and fourth rings.¹¹ A tracheotomy tube of appropriate size and curve is inserted after the endotracheal tube has been withdrawn, under vision, to the upper limits of the tracheal incision. The tube should be secured with tapes, tied with a square knot. A single silk suture is usually placed near each end of the incision after the tube is in place.

The advantages in doing tracheotomy over a tube have been recognized for many years. Certainly, comfort to the surgeon is an important consideration. The conversion of an emergency to a planned procedure is of advantage to the patient beyond the instantaneous relief of his respiratory distress. It virtually eliminates the hazard of pneumothorax, whether it be spontaneous from gross respiratory effort, or secondary to surgically opening the pretracheal space in the presence of respiratory obstruction, or from injury to the dome of the pleura while dissecting in the neck under difficult conditions. Also eliminated is the danger of massive hemorrhage from anomalous large vessels.⁹

Bigler and Holinger³ advised doing tracheotomy over a tube in all cases with the exception of those with deformity of the cricoid cartilage or complete laryngeal atresia, in which it is impossible to intubate the patient. In these fortunately rare cases, tracheotomy must be performed immediately if the newborn infant is to survive. Davidson⁴ cited the case of an 8-year-old with pronounced tracheal

TABLE 1.—Reasons for Tracheotomy in 13½-Year Period Through December 1959 at Children's Hospital of the East Bay

	No. of Cases
Laryngotracheobronchitis	48
Epiglottitis	13
Associated with other surgical procedures.....	20
Thoracic operation	7
Tumors face and neck.....	4
Endoscopy	4
Postsurgery aspiration	1
Neurosurgical procedure	1
Plastic operation	1
Acute injury	2
Congenital anomaly	7
Tetanus	2
Subglottic stenosis	2
Meningitis	1
Bulbar poliomyelitis	1

crusting and glottic swelling, in which he felt that placing a flexible endotracheal tube before tracheotomy would have been less satisfactory than introducing a bronchoscope, since preliminary removal of the crusts was necessary before the obstruction was relieved.

With rare exceptions, then, the endotracheal tube will be found to be as useful as the rigid bronchoscope for the emergency relief of obstruction before tracheotomy. Once in place it is safer because of its flexibility, and the patient can be moved as required, without the problem of keeping him in proper position in relationship to a rigid tube. Furthermore, an adequate endotracheal tube intubation set is simpler and less expensive to supply than a limited bronchoscopic set. Sets can be kept at hand at several locations in a hospital, and may be carried in a physician's bag.

Meticulous postoperative care is an essential feature in avoiding development of a keloid of the wound, granulations in the trachea and eventual stenosis of the trachea at the site of tracheostomy. Baker,² who wrote in detail about this phase of tracheotomy, advised daily changes of the tube after the first 48 to 72 hours. It is wise to have an intubation set at the bedside during the first change

of tube; also an extra tube one size smaller than the tube to be replaced.

Tracheotomy was done 94 times in a period of thirteen and a half years at Children's Hospital of the East Bay for the reasons shown in Table 1. In 65 per cent of cases the operation was for the relief of obstruction secondary to acute respiratory infection. Of this group, one patient was operated upon twice, at 30 months, and again at four years of age, for obstruction due to acute laryngotracheobronchitis.

Pneumothorax was the only complication directly related to the operation. It occurred in four cases and in each instance was apparently caused by the tracheotomy tube slipping out of the trachea. There was one death in this group. In the other three cases simple aspiration of air from the pleural cavity was all that was necessary.

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